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A new species of *Aulacus* (Hymenoptera, Aulacidae) from Hokkaido, Japan

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Abstract

Aulacus machaerophorus **sp. n.** is described from females collected in Sapporo, Hokkaido, Japan. This new species has some interesting characteristics such as a very short ovipositor, absence of a ventral lobe and ovipositor guide on hind coxa, and smooth and shiny axillula, and is considered to be closely related to Nearctic species, *A. schiffi*. A key to three Japanese species of *Aulacus* is given.

Keywords

Aulacidae, *Aulacus*, Evanioidea, Hymenoptera, new species, taxonomy

Introduction

Aulacus Jurine, 1807 is composed of 78 extant species and has been recorded from all biogeographical regions except Antarctica and the Afrotropical (Chen et al. 2016). Wasps of this family are koinobiont endoparasitoids and use Xiphydriidae (Hymenoptera) and Buprestidae and Cerambycidae (Coleoptera) as hosts (Chen et al. 2016; Jennings and Austin 2004; Smith 2001). Aulacidae consists of two genera, *Aulacus* and *Pristaulacus*. *Aulacus* is distinguished from *Pristaulacus* by the following features: occipital carina absent; tarsal claw with a basal tooth or none; pronotum without a dentiform process

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along latero-ventral margin; petiole slender, at least 2.5 times as long as wide. *Aulacus* is considered to be a paraphyletic group with respect to *Pristaulacus* (Turrisi et al. 2009).

Seven species of *Aulacus* have been recorded from the Palaearctic Region, with two from Japan, *A. japonicus* Konishi, 1990 from Iwate, Tohoku and *A. uchidai* Turrisi and Konishi 2011 from Hokkaido (Konishi 1990; Turrisi and Konishi 2011). Recently, we collected *Aulacus* specimens from Sapporo, Hokkaido, and found that they have distinctive and peculiar characteristics separate them the known species. Here we describe a new species based on these specimens.

Materials and methods

Specimens used in this study are dried except one which is preserved in 99% ethanol. They are deposited as follow: Hokkaido University Museum, Sapporo, Japan (SEHU); the Ehime University Museum, Matsuyama, Japan (EUM); and National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (USNM). Morphological technical terms follow Huber and Sharkey (1993) and surface sculpture follows Eady (1968). The methods of measurements follow Konishi (1990) and Smith (2008), and measured traits are shown in Fig. 1. In this paper, we use the following abbreviations: **OOL** = distance between outer margin of posterior ocellus and eye; **POL** = distance between inner margins of posterior ocelli. Most photographs (Figs 1–14) were obtained at the Laboratory of Environmental Entomology, Ehime University, using a Nikon Digital Sight DS-Fi1 camera attached to a Leica S8APO stereomicroscope. Fig. 15 was taken under a digital microscope

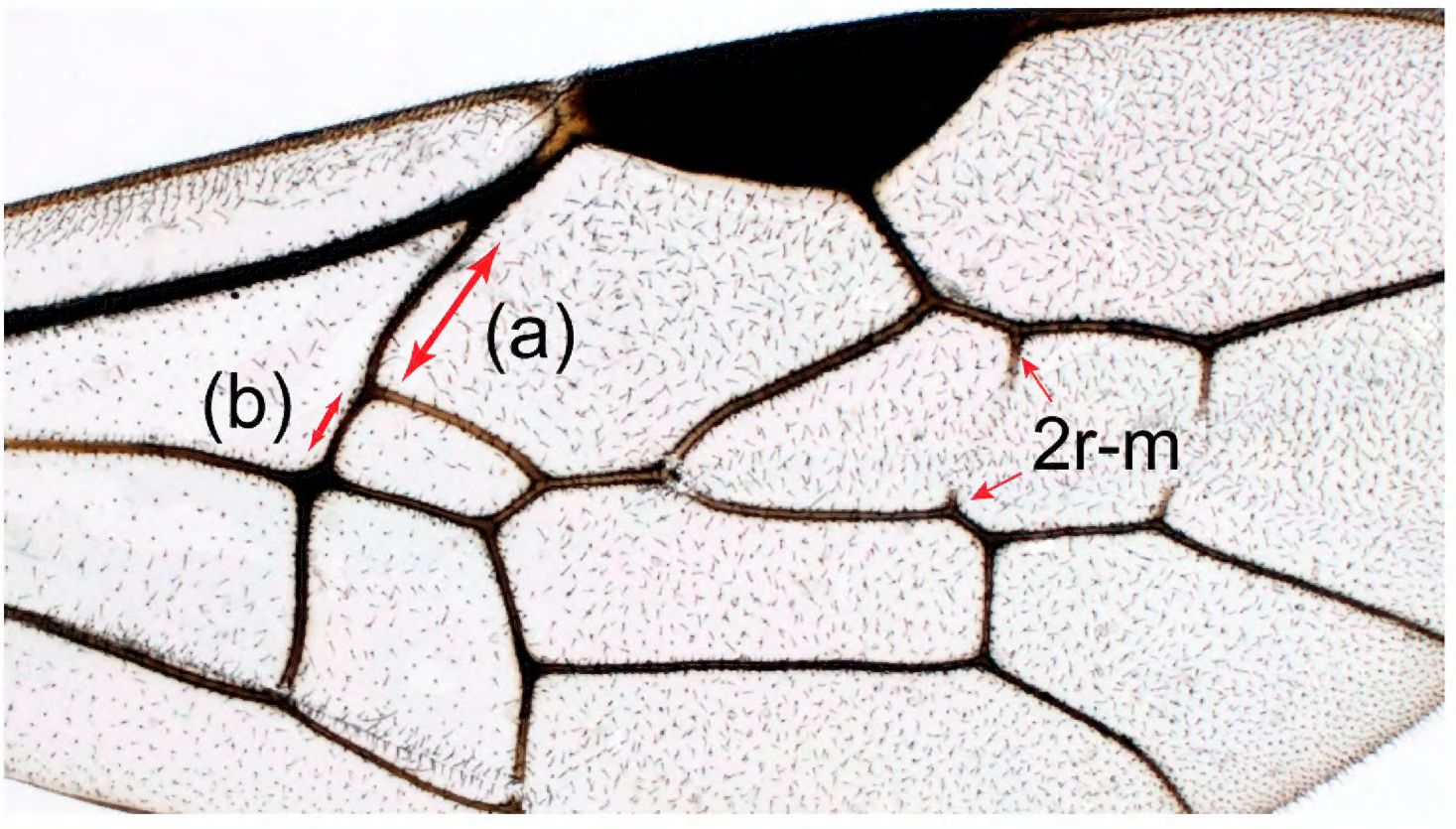

Figure 1. Methods for measurements of wing venation: **a** *Rs* between 1*R* and *Rs+M* **b** *M* between *Rs+M* and *M+Cu*.

HiROX KH-1300 and the image captured with the 2D measurement software SHX-13M ver. 2.9.0. Several partially focused images were combined and post-processed using Adobe Photoshop® CS6.

Taxonomy

Genus *Aulacus* Jurine

Aulacus Jurine, 1807: 89.

Type species. *Aulacus striatus* Jurine, 1807. By monotypy.
See Smith (2001) for complete synonymy.

Aulacus machaerophorus sp. n.

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Figs 2–15

Holotype. ♀ "43°2.85'N, 141°18.96'E, Mt. Maruyama, Chuo-ku, Sapporo-shi, Hokkaido, Japan", labelled "JPN: Hokkaido, Sapporo-shi, Chuo-ku, Mt. Maruyama, 1. Aug. 2016, Keita Kuroda leg." (EUM). **Paratypes.** Same location as holotype but different dates and collected by Namiki Kikuchi: 1 ♀, 27 July, 2015: 1 ♀, 10 August, 2015: 6 ♀, 31 July, 2016: 5 ♀, 1 August, 2016: 7 ♀, 2 August, 2016 (SEHU). 6 ♀, same data as holotype (3 ♀ in EUM and 3 ♀ in USNM). 6 ♀, same data as holotypes but different dates: 2 ♀, 31 July 2016: 4 ♀ (3 dried and 1 wet), 2 August 2016 (EUM).

Description of female. Length: 4.1–6.5 mm

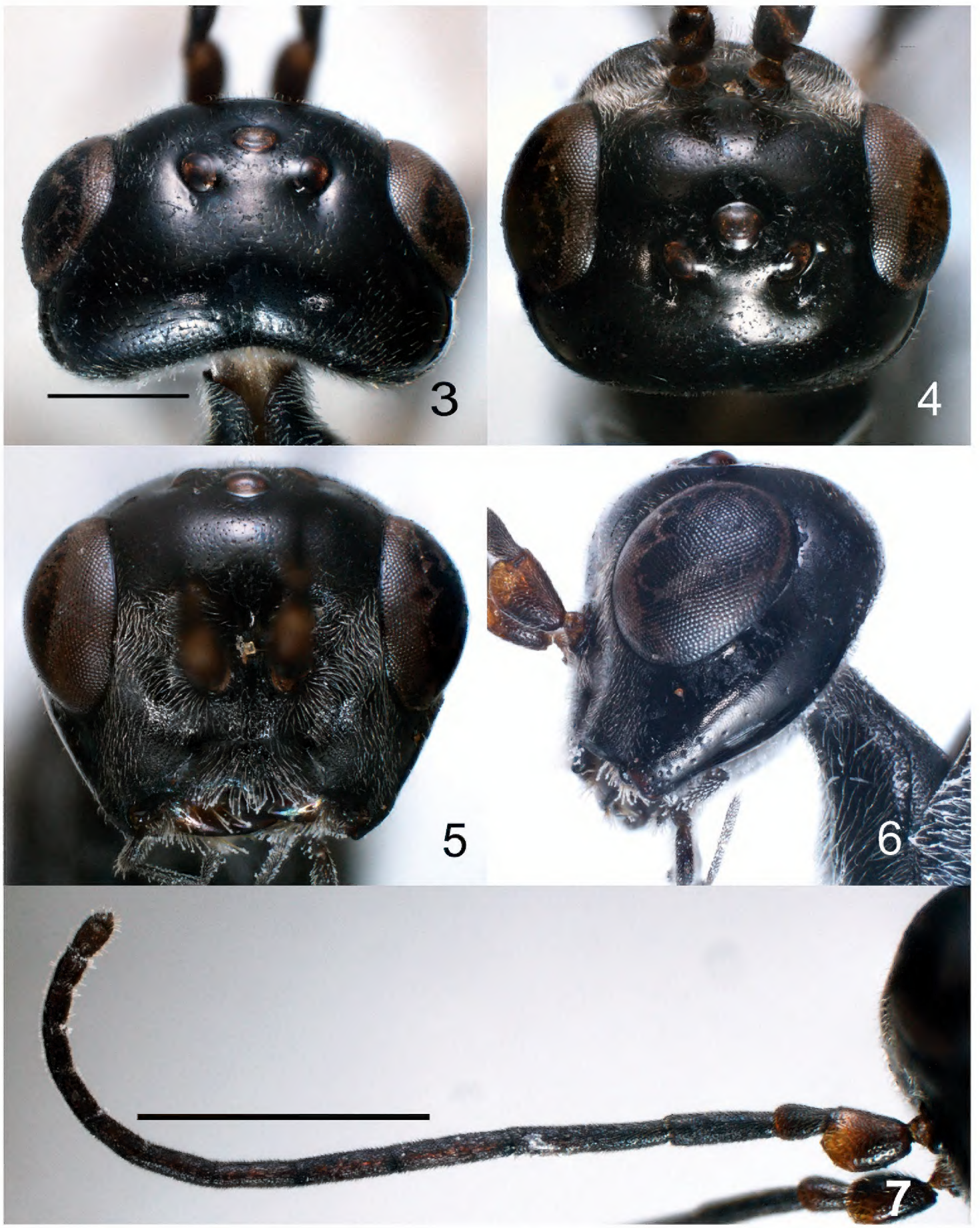
Color: Black; median portion of mandible yellowish brown; apical 1/3 to entire scape yellowish brown; apical portion of pedicel yellowish brown; trochanter yellowish brown to black; basal and apical portions of femora yellowish brown; fore tibia yellowish brown; mid tibia yellowish brown, sometimes black with basal and apical portions yellowish brown; hind tibia with basal and apical portions yellowish brown; fore and middle tarsi yellowish brown to light yellowish brown; hind tarsus yellowish brown, sometimes dark yellowish brown; wings hyaline, stigma and veins black; setae silver, setae on mandible gold.

Head glossy (Figs 3–7), 0.6–0.7 times as long as wide; lower area of gena coriaceus; malar space 0.4–0.5 times as long as eye height; head length behind eye in dorsal view 0.4–0.5 times as long as eye height; lower interocular distance 1.2–1.4 times as long as eye height; posterior margin of head weakly concave in dorsal view; occiput and postocciput smooth with dense setae and punctures; temple smooth; vertex smooth, with setae and sparse punctures, coriaceus between eye and posterior ocellus; OOL:POL=1:1; frons coriaceus and sparsely punctate with setae; antennal socket situated at about lower level of eye, separated from anterior tentorial pit by its own diam-

Figure 2. *Aulacus machaerophorus* sp. n. lateral habitus. Scale bar: 1.0 mm.

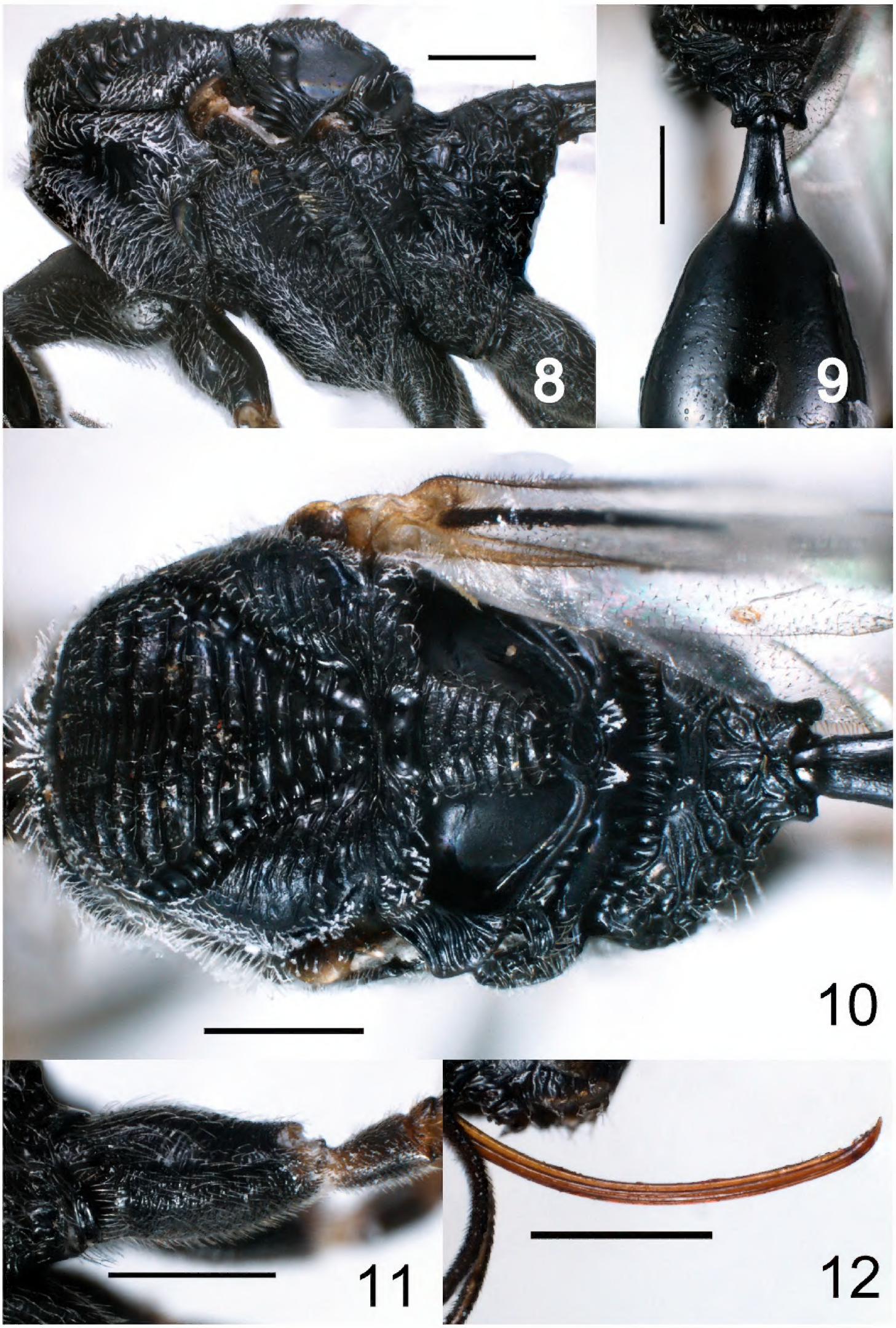
eter; face densely punctate with setae and coriaceus-granulate; clypeus granulate and densely punctate with setae, with a protuberance situated at middle of apical margin; punctures on face and clypeus much stronger and denser than on temple; mandible smooth, basal area and upper half with some setae; antenna (Fig. 7) with fine hairs, 3.1–4.4 times as long as head length; pedicel 1.4–1.9 times as long as wide; 1st flagellomere 3.0–4.0 time as long as wide, 0.6–0.7 time as long as 2nd.

Mesosoma glossy (Fig. 8 & Fig. 10), punctate with setae; propleuron reticulate rugose along dorsal edge, antero-dorsal portion reticulate rugose, canaliculate along ventral edge; upper pronotum with subtriangular smooth area surrounded by crenulate furrows, lower pronotum with punctures and dense setae; mesoscutum transversely strigate; notauli moderately narrow and canaliculate, meeting at posterior margin of mesoscutum; scutellum transversely strigate; axillula smooth, shiny; mesopleuron canaliculated-reticulate, epicnemium smooth, with some punctures and setae; mesosternum with dense setae and punctures, reticulate rugose; metanotum smooth, anterior half with canaliculate furrow except median 1/3 with longitudinal ridges; metapleuron reticulate rugose and sparsely punctate with setae; propodeum with dorsal surface rugose and anterior 1/4 with transverse canaliculate furrow, with lateral surface and posterior surface reticulate rugose.

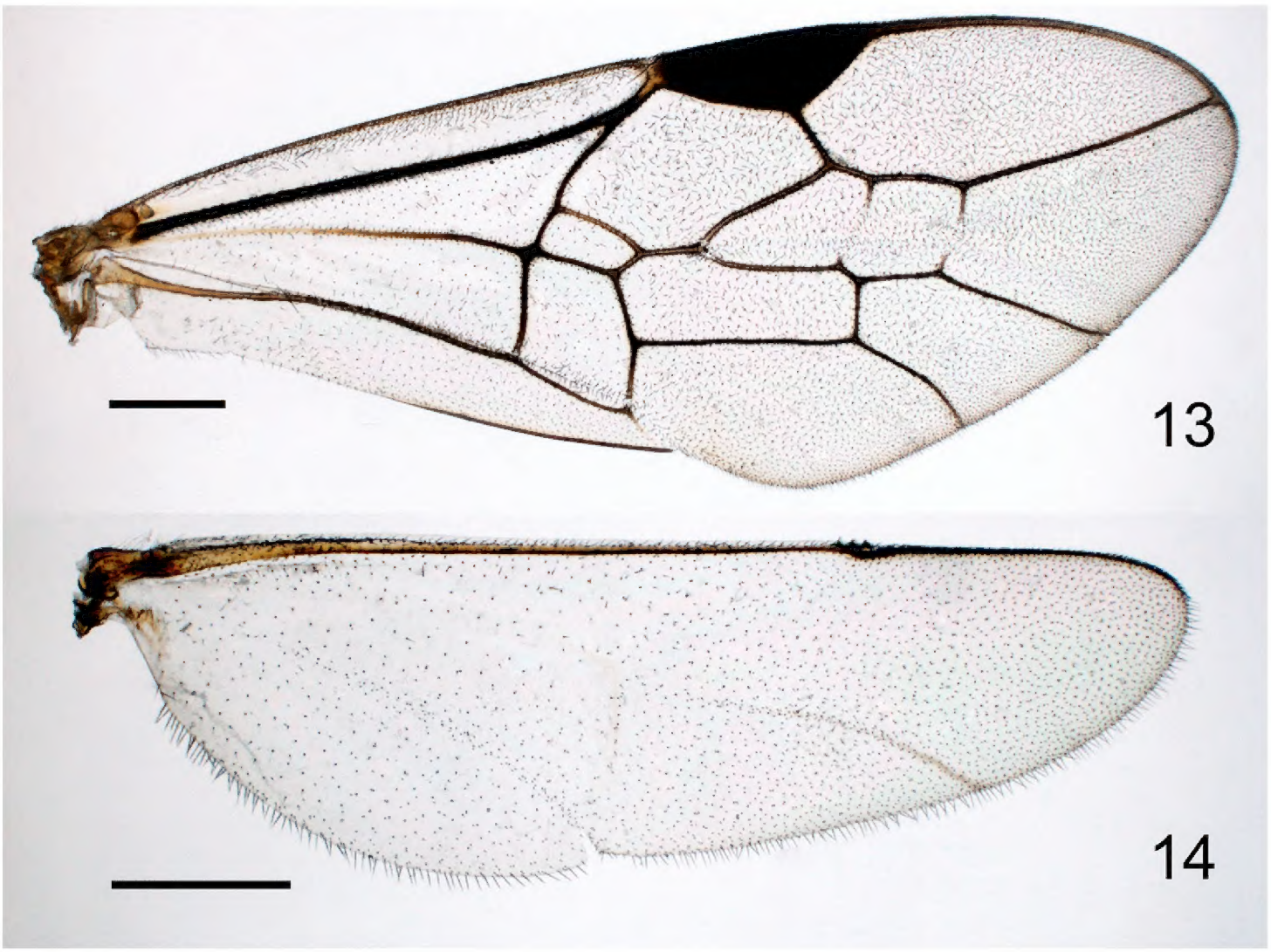


Figures 3–7. *Aulacus machaerophorus* sp. n. **3** head, dorsal view **4** frons, frontal view **5** face, frontal view **6** head, lateral view **7** antenna, dorsal view. Scale bars: 0.5 mm (**3–6**), 1.0 mm (**7**).

Legs: Coxae setose and trans-strigate; hind coxa (Fig. 11) 1.9–2.3 times as long as wide, without ventral lobe and ovipositor guide; tibiae with dense setae and puncture; tarsi with dense spines and punctures; hind basitarsus 1.1–1.4 times as long as length of remaining tarsomeres combined; hind tarsal claw with a basal tooth.



Figures 8–12. *Aulacus machaerophorus* sp. n. **8** mesosoma, lateral view **9** metasoma, dorsal view **10** mesosoma, dorsal view **11** hind coxa, lateral view **12** ovipositor. Scale bars: 1.0 mm.



Figures 13–14. *Aulacus machaerophorus* sp. n. **13** fore wing **14** hind wing. Scale bars: 0.5 mm.

Wings: Fore wing (Fig. 13) 3.1–5.1 mm long and 2.6–3.4 times as long as wide; stigma 2.3–3.8 times as long as wide, length of stigma basad *r-rs* 1.2–1.4 times as long as length of stigma distad *r-rs*; *M+Cu* with distal tubular portion as long as basal non-tubular portion; cell M 1.9–3.0 times as long as wide; cell 1R 1.5–1.9 times as long as wide; *Rs* between 1*R* and *Rs+M* 1.7–2.8 times as long as *M* between *Rs+M* and *M+Cu* (Fig. 1); *r-rs* 0.7–1.0 times as long as stigma width; anteriorly 2/5 and posteriorly 1/10 of 2*r-m* distinct; *Cu* curved downward; hind wing (Fig. 14) weakly tapering toward rounded apex, 3.3–3.9 times as long as wide and with 3 hamuli; *M* of apical portion colored.

Metasoma glossy (Fig. 10); petiole 2.1–3.2 times as long as wide; 1st tergum smooth; 1st sternum with strong longitudinal furrows; 2nd to 5th terga coriaceus and 2nd tergite without setae and punctures, 3rd to 7th terga with sparse setae and punctures; 2nd to 5th sterna coriaceus; ovipositor 0.8–1.1 mm long and 0.2–0.3 times as long as fore wing, 1.1–1.7 times as long as hind coxa; ovipositor (Fig. 12) strongly upcurved near apex and with some setae on dorsal valve near apex (Fig. 15); ovipositor sheath with dense short hairs; second gonocoxa with setae and punctures; apical portion of ovipositor sheath weakly enlarged and rounded.

Male. Unknown.

Distribution. Japan (Hokkaido).

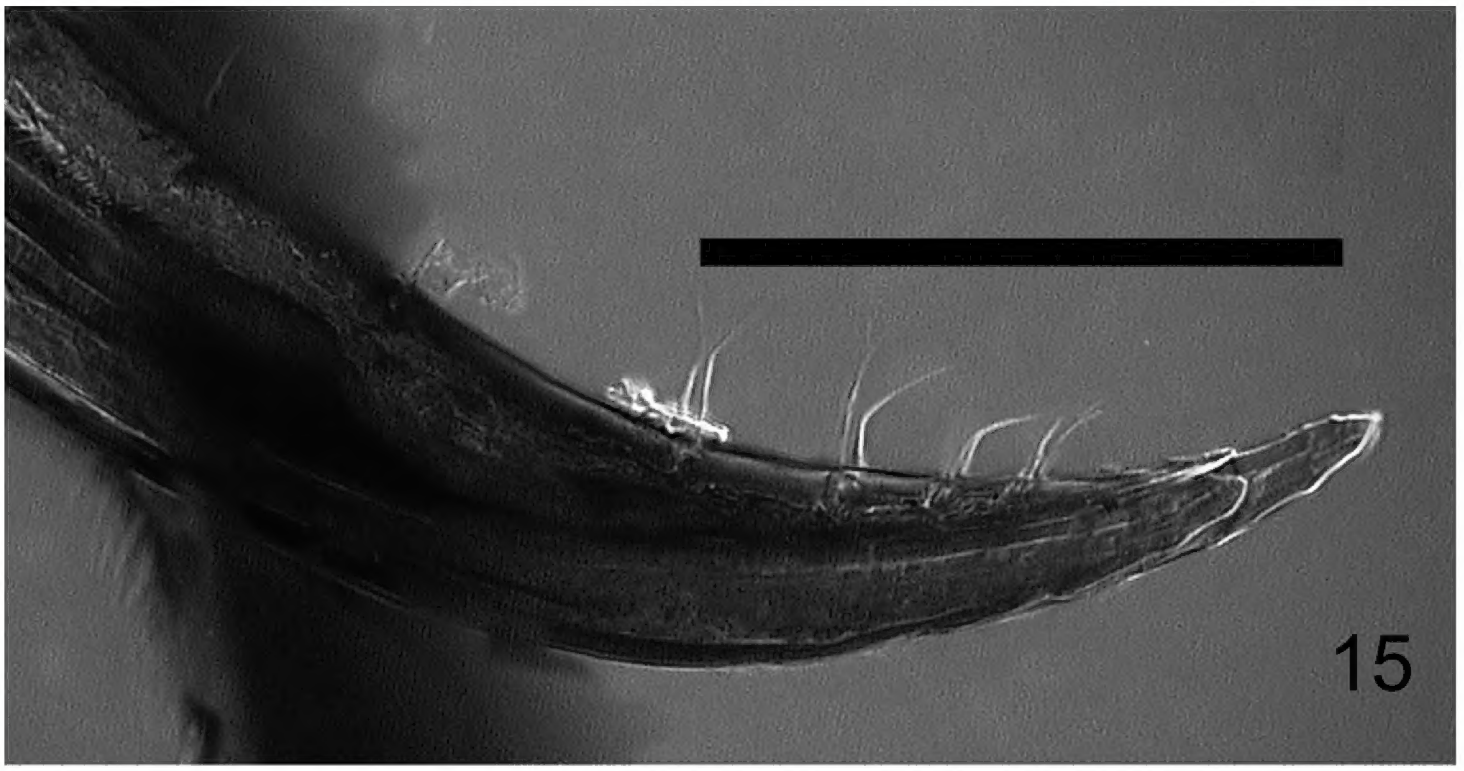


Figure 15. *Aulacus machaerophorus* sp. n. setae of ovipositor on dorsal valve near apex. Scale bar: 0.1 mm.

Biology. All specimens used in this study were collected on the tree trunk of a blighted broad leaf tree in a broad-leaved forest.

Etymology. From the Latin *machaerophorus*, meaning bearing a short sword. This new species has a short ovipositor like a short sword.

Remarks. This new species possesses the following peculiar features: frons without transverse carina and rugulose sculpture; axillula smooth, shiny; hind coxa without ventral lobe and ovipositor guide; ovipositor very short (0.2–0.3 times as long as fore wing); apical portion of ovipositor with some short setae.

In *Aulacus* species so far described, a Nearctic species, *A. schiffi* Smith, 1996 is considered to be most closely related to *A. machaerophorus*. They share the short ovipositor; hind coxa without projecting ventral lobe and ovipositor guide; smooth frons without transverse carina; and ovipositor with setae (Smith, personal communication). Among these characteristics, the presence or absence of setae on ovipositor has not been reported in other *Aulacus* species and therefore needs further examination. *Aulacus machaerophorus* can be separated from *A. schiffi* by the absence of diagonal carinae on the axillula, the shorter ovipositor (ovipositor is 0.5 times as long as fore wing in *A. schiffi*) and wing venation (*A. schiffi* has a longer discal cell, $2Rs+M$ between the discal and submarginal cells is much shorter, and $2r\text{-}m$ is absent). This relationship of *A. machaerophorus* and *A. schiffi* is suggest close relationships of some of the fauna and flora of eastern Asia and eastern North America. For example, relationship of North American and eastern Asian species of *Stronglygaster* (Tenthredinidae) (Smith and Naito 1995) and example of the flora see Tiffney (1985).

Other Palaearctic species have rugulose frons with transverse carina judging from figures in Chen et al. (2016) and Sundukov and Lelej (2015). On the other hand, Australian and Nearctic *Aulacus* species have the frons with or without transverse carinae

and the hind coxa with or without a ventral lobe and ovipositor guide (Jennings et al. 2004; Smith 2008).

This new species can be distinguished from two Japanese species by the following key.

Key to Japanese species – females

1 Frons without transverse carina, smooth (Fig. 5); axillula smooth (Fig. 10); fore wing with anterior part of 2*r-m* (Fig. 1); hind coxa without ventral lobe and ovipositor guide (Fig. 11).....***A. machaerophorus*, sp. n.**

– Frons with transverse carinae, rugulose-foveolate or rugulose; axillula reticulate rugose; fore wing without anterior part of 2*r-m*; hind coxa with ventral lobe.....**2**

2 Ovipositor 0.6–0.9 times as long as fore wing length; frons less extensively sculptured and weakly rugulose-foveolate .....***A. uchidai* Turrisi & Konishi**

– Ovipositor 0.4 times as long as fore wing length; frons rugulose ....***A. japonicus* Konishi**

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References

Chen H, Turrisi GF, Xu Z (2016) A revision of the Chinese Aulacidae (Hymenoptera, Evanioidea). ZooKeys 587: 77–124. https://doi.org/10.3897/zookeys.587.7207

Eady RD (1968) Some illustrations of microsculpture in Hymenoptera. Proceedings of the Royal Entomological Society of London (A) 43: 66–72. https://doi.org/10.1111/j.1365-3032.1968.tb01029.x

Huber JT, Sharkey MJ (1993) Structure. In: Goulet H, Huber JT (Eds) Hymenoptera of the World: An Identification Guide to Families. Research Branch Agriculture Canada, Publication 1894/E; Centre for Land and Biological Resources Research, Ottawa, 13–33.

Jennings JT, Austin AD (2004) Biology and host relationships of aulacid and gasteruptiid wasps (Hymenoptera: Evanioidae): a review. In: Rajmohana K, Sudheer K, Girish KP, Santhosh S (Eds) Perspectives on Biosystematics and Biodiversity. University of Calicut, Kerala, 187–215.

Jennings JT, Austin AD (2006) Aulacid wasps (Hymenoptera: Aulacidae) of New Guinea, with descriptions of five new species. Zootaxa 1365: 19–35.

Jennings JT, Austin AD, Stevens NB (2004) Species of the genus *Aulacus* Jurine (Hymenoptera: Aulacidae) endemic to South Australia. Transactions of the Royal Society of South Australia 128(1): 13–21.

Jurine L (1807) Nouvelle Méthode de Classer les Hyménoptères et les Diptères. Hyménoptères. Tome Premier. Genève, 319 pp.

Konishi K (1990) A revision of the Aulacidae of Japan (Hymenoptera, Evanioidea). Japanese Journal of Entomology 58(3): 637–655.

Smith DR, Naito T (1995) A new species of *Strongylogaster* (Hymenoptera: Tenthredinidae) from North America. Entomological News 106(2): 57–60.

Smith DR (1996) Aulacidae (Hymenoptera) in the mid-Atlantic states, with a key to species of eastern North America. Proceedings of the Entomological Society of Washington 98: 274–291.

Smith DR (2001) World catalog of the family Aulacidae (Hymenoptera). Contributions on Entomology, International 4(3): 263–319.

Smith DR (2008) Aulacidae of the southwestern United States, Mexico, and Central America (Hymenoptera). Beiträge zur Entomologie 58: 267–355.

Sundukov YN, Lelej AS (2015) Review of the family Aulacidae (Hymenoptera: Evanioidea) in the Russian Far East. Euroasian Entomological Journal 14(2): 107–118.

Tiffney BH (1985) Perspectives on the origin of the floristic similarity between eastern Asia and eastern North America. Journal of the Arnold Arboretum 66: 73–94. https://doi.org/10.5962/bhl.part.13179

Turrisi GF, Jennings JT, Vilhelmsen L (2009) Phylogeny and generic concepts of the parasitoid wasp family Aulacidae (Hymenoptera: Evanioidea). Invertebrate Systematics 23: 27–59. https://doi.org/10.1071/IS08031

Turrisi GF, Konishi K (2011) Description of two new Aulacidae (Hymenoptera: Evanioidea) from Japan. Zootaxa 2872: 35–48.